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able of judging sanely neither about the amount of pain involved nor the importance of the knowledge to be obtained. Says President Eliot of Harvard University:

The humanity which would prevent human suffering is a deeper and truer humanity than the humanity which would save pain or death to animals.

Moreover, the experiments give knowledge which saves pain not only to millions of human beings, but in many cases to animals themselves. In tuberculosis, for instance, the men of science are fighting for cattle as well as for men; in lockjaw, for horses as well as for our own kind. The marvelous results in diphtheria have happily now become known to almost every mother. To stop animal experimentation would check the advance of surgery. It would take away our strongest weapon in the promising fight being waged against cerebro-spinal meningitis, bubonic plague, dysentery and malaria. It would reduce us to despair in the harder but still hopeful contest with cancer.—*Collier's Weekly*.

SCIENTIFIC BOOKS

The Manufacture of Explosives—Twenty Years' Progress. By OSCAR GUTTMANN. 8vo, 84 pp., 11 illustrations. New York, The Macmillan Company. 1909. Price \$1.10 net.

The major title of this book is identical with that of the well-known two-volume work by the same author which was published in 1895. The make-up of the new volume is similar to that of the older ones and it may properly be regarded as a supplement to them. The significance of the subtitle is not apparent on a close reading of the text, for the first installment begins with an historical résumé from 1250 to 1886, and this same method of treatment obtains throughout the book as new topics are introduced. Even taking 1886 as the point of departure, this date precedes the publication of the first volumes by nine years, so that there is necessarily some repetition in the supplement, but much of it is avoided by referring to the descriptions published in the earlier volumes. Nevertheless, this feature should be borne in mind when citing this au-

thor in litigation or for historical precedence and the statements of the supplement should be carefully compared with those of the major parts.

This condition has arisen from the fact that the present volume is a record of four Cantor lectures delivered before the Royal Society of Arts in 1908 and that such historical résumés were deemed necessary to properly introduce the topics. Lecture I. deals with black powder and other nitrate mixtures, chlorate mixtures, "metallic" explosives, picric acid, picrates and trinitrotoluol; lecture II. with nitroglycerine, dynamites, guncotton and nitro-starch; lecture III. with smokeless and flameless powders, fulminates, detonators and fuses, safety explosives and their use, particularly in mines; lecture IV. with the use of nitrocellulose in other industries, the construction, lighting and inspection of factories, accidents and precautions to be taken, the merits and demerits of explosives, stability of explosives and stabilizing agents, and finishes with a prophecy regarding the powder of the future.

The author holds a very poor opinion of nitrocellulose as a material from which to make smokeless powder, though all smokeless powders now adopted for military and naval use are composed of nitrocellulose alone or mixed with nitroglycerine, and he predicts that a stable nitro-compound of the aromatic series alone, or in conjunction with nitroglycerine, will come into use so soon as some government finds the courage to make the change. He likewise regards picric acid, which has been adopted by almost every country as a disruptive agent, under names such as melinite, lyddite, shimose powder, ecrasit and others, as a treacherous substance and expresses the hope that we shall some day give up its use.

Considering the use of explosives in mines, he points out the difficulty of determining what makes an explosive safe in fire damp. Thus since mercuric fulminate ordinarily does not ignite fire damp, while black powder does the Prussian Commission state that the more rapid the explosion the safer the explosive, yet certain black powder mixtures like bob-

binite are safe up to a certain point while nitroglycerine and blasting gelatine are not. The French Commission decided that an explosive whose temperature of explosion, as calculated by certain thermochemical data, was below $1,500^{\circ}\text{C}.$, could be licensed for use in fiery mines, yet carbonite, which is one of the safest of all, and several others in use, have a temperature of explosion considerably above $1,500^{\circ}\text{C}.$ Bichel and Mettegang, whose investigations in this field are highly praised, require slow detonation as one of the characteristics of a safe explosive, yet "the velocity of detonation can not, however, be considered to be a determining factor under all circumstances. Certain nitroglycerine explosives, amongst which we may also include carbonite, explode much more rapidly than, say bobbinite, and yet show themselves to be much safer when tested." Even in making firing tests in galleries, as is now being done by several governments and organizations, the author finds that the results differ with the shape and dimensions of the galleries, so that each gallery may have its own ignition temperature which would affect the results obtained.

In discussing this topic the author says: "It has been known for a long time that coal dust as well as pit gas is highly explosive," while he knows perfectly well that neither coal dust nor pit gas is explosive by itself, though they may form explosive mixtures with the air. Also in discussing "smokeless," "flameless" and "safety" explosives he fails to point out that these terms are used in the art in a purely relative sense and that an explosive possessing these purely negative qualities absolutely does not exist. Justice requires us to state, however, that when discussing catastrophes in explosive works he says: "The author has always warned manufacturers and users alike that the function of an explosive is to explode, and that although certain compositions are almost insensitive to ordinary impulses, such as blows, friction, etc., yet he never believed that any explosive existed which under favorable conditions and by proper means could not be made to ex-

plode," but this point is emphasized because in a publication such as this, which may be cited as authority in litigation in which important interests are involved, care should be taken that no loose terms or unqualified phrases regarding the properties of matter are used.

Surprise is expressed at the extent to which black powder is still being used, it being stated that 7,000 tons of it were used in the mines and quarries of Great Britain, and 3,597 tons exported in 1907, making 10,597 tons in all. This is markedly less than the output of the United States, where the production of black powder at the census of 1900 was 62,412 short tons and at that of 1905 was 107,910 short tons. In fact, since the statistics of this industry in the United States were first separately taken, at the census of 1840 there has been a constant increase at each decade, and this failure of "smokeless" powder to supplant black powder was commented on with fullness in the Census Bulletin for 1900.

The book is filled with information, much of which is quite up to date, and it bristles with references, a large part of which are to British patents. A defect is in its limited use of American sources, patent or other readily accessible literature, for a country which produced 363,748,097 pounds of explosives of all kinds in the census year 1905 can not have failed to have made useful contributions to the progress of the art. Nevertheless, the book is a good one. It is more than a compilation, for it is thoughtful, critical and sometimes controversial. Every one of the many who possess the parent volumes must also acquire this and they will be pleased to have done so.

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Birds of the World. By FRANK H. KNOWLTON, Ph.D., with a Chapter on the Anatomy of Birds by FREDERIC A. LUCAS. The whole edited by ROBERT RIDGWAY. With 16 colored plates and 236 other illustrations. American Nature Series, Group 1, Natural History, pp. i-xiv, 1-874. New York, Henry Holt & Co. 1909.